(v) If the number of remaining data points is less than seven, take corrective action by checking your calibration data or repeating the calibration process. If you repeat the calibration process, we recommend checking for leaks, applying tighter tolerances to measurements and allowing more time for flows to stabilize.

(vi) If the number of remaining K_v values is seven or greater, recalculate the mean and standard deviation of the remaining K_v values.

(vii) If the standard deviation of the remaining K_v values is less than or equal to 0.3% of the mean of the remaining K_v, use that mean K_v in Eq 1066.630–7, and use the CFV values only up to the highest r associated with the remaining K_v.

(viii) If the standard deviation of the remaining K_v still exceeds 0.3% of the mean of the remaining K_v values, repeat the steps in paragraph (c)(1)(iv) through (vii) of this section.

(2) During exhaust emission tests, monitor sonic flow in the CFV by monitoring r. Based on the calibration data selected to meet the standard deviation criterion in paragraphs (c)(1)(iv) and (vii) of this section, in which K_v is constant, select the data values associated with the calibration point with the lowest absolute venturi inlet pressure to determine the r limit. Calculate r during the exhaust emission test using Eq. 1066.625–8 to demonstrate that the value of r during all emission tests is less than or equal to the r limit derived from the CFV calibration data.

§ 1066.630 PDP, SSV, and CFV flow rate calculations.

This section describes the equations for calculating flow rates from various flow meters. After you calibrate a flow meter according to § 1066.625, use the calculations described in this section to calculate flow during an emission test. Calculate flow according to 40 CFR 1065.642 instead if you calculate emissions based on molar flow rates.

(a) *PDP*. (1) Based on the speed at which you operate the PDP for a test interval, select the corresponding slope, a_1, and intercept, a_0, as determined in § 1066.625(a), to calculate PDP flow rate, $\dot{Q}$, as follows:

$$\dot{Q} = f_{\mathrm{nPDP}} \cdot \frac{V_{\mathrm{rev}} \cdot T_{\mathrm{std}} \cdot p_{\mathrm{in}}}{T_{\mathrm{in}} \cdot p_{\mathrm{std}}}$$

Eq. 1066.630-1

Where:

f_{nPDP} = pump speed.

V_{rev} = PDP volume pumped per revolution, as determined in paragraph (a)(2) of this section.

T_{std} = standard temperature = 293.15 K.

p_{in} = static absolute pressure at the PDP inlet.

T_{in} = absolute temperature at the PDP inlet.

p_{std} = standard pressure= 101.325 kPa.

(2) Calculate V_{rev} using the following equation:

$$V_{\mathrm{rev}} = \frac{a_1}{f_{\mathrm{nPDP}}} \cdot \sqrt{\frac{p_{\mathrm{out}} - p_{\mathrm{in}}}{p_{\mathrm{out}}}} + a_0$$

Eq. 1066.630-2

p_{out} = static absolute pressure at the PDP outlet.

Where:

C_d = discharge coefficient, as determined based on the C_d versus $Re^{\#}$ equation in § 1066.625(b)(2)(viii).

C_f = flow coefficient, as determined in § 1066.625(b)(2)(ii).

A_t = venturi throat cross-sectional area.

R = molar gas constant.

p_{in} = static absolute pressure at the venturi inlet.

T_{std} = standard temperature.

p_{std} = standard pressure.

Z = compressibility factor.

M_{mix} = molar mass of gas mixture.

T_{in} = absolute temperature at the venturi inlet.

Example:

$C_d = 0.890$

$C_f = 0.472$

$A_t = 0.01824\ \text{m}^2$

$R = 8.314472\ \text{J/(mol·K)} = 8.314472\ (\text{m}^2\text{·kg})/(\text{s}^2\text{·mol·K})$

$p_{in} = 98.496\ \text{kPa}$

$T_{std} = 293.15\ \text{K}$

$p_{std} = 101.325\ \text{kPa}$

$Z = 1$

$M_{mix} = 28.7789\ \text{g/mol} = 0.0287789\ \text{kg/mol}$

$T_{in} = 296.85\ \text{K}$

$$\dot{Q} = 0.89 \cdot 0.472 \cdot \frac{0.01824 \cdot 8.314472 \cdot 98.496 \cdot 293.15}{101.325 \cdot \sqrt{1 \cdot 0.0287805 \cdot 8.314472 \cdot 296.85}}$$

$$\dot{Q} = 2.155\ \text{m}^3/\text{s}$$

(c) *CFV.* If you use multiple venturis and you calibrated each venturi independently to determine a separate calibration coefficient, K_v, for each venturi, calculate the individual volume flow rates through each venturi and sum all their flow rates to determine CFV flow rate, $\dot{Q}$. If you use multiple venturis and you calibrated venturis in combination, calculate $\dot{Q}$ using the K_v that was determined for that combination of venturis.

(1) To calculate $\dot{Q}$ through one venturi or a combination of venturis, use the mean K_v you determined in §1066.625(c) and calculate the appropriate quantity for $\dot{Q}$ as follows:

$$\dot{Q} = \frac{K_v \cdot p_{in}}{\sqrt{T_{in}}}$$

Eq. 1066.630-7

Where:

K_v = flow meter calibration coefficient.

T_{in} = temperature at the venturi inlet.

p_{in} = absolute static pressure at the venturi inlet.

Example:

$K_v = 0.074954 \text{ m}^3 \cdot \text{K}^{0.5}/(\text{kPa} \cdot \text{s})$

$p_{in} = 99.654 \text{ kPa}$

$T_{in} = 353.15 \text{ K}$

$$\dot{Q} = \frac{0.074954 \cdot 99.654}{\sqrt{353.15}}$$

$\dot{Q} = 0.39748 \text{ m}^3/\text{s}$

(2) [Reserved]

§ 1066.635 NMOG determination.

For vehicles subject to an NMOG standard, determine NMOG as described in paragraph (a) of this section. Except as specified in the standard-setting part, you may alternatively calculate NMOG results based on measured NMHC emissions as described in paragraphs (c) through (f) of this section.

(a) Determine NMOG by independently measuring alcohols and carbonyls as described in 40 CFR 1065.805 and 1065.845. Use good engineering judgment to determine which alcohols and carbonyls you need to measure. This would typically require you to measure all alcohols and carbonyls that you expect to contribute 1% or more of total NMOG. Calculate the mass of NMOG in the exhaust, m_{NMOG}, with the following equation, using density values specified in §1066.1005(f):